Validation of Wearable Derived Heart Rate Variability and Oxygen Saturation from the Garmin's Health Snapshot

Kieran Williams, Alexandra Jamieson, Nishi Chaturvedi, Alun Hughes, Michele Orini

MRC Unit for Lifelong Health and Aging, Institute of Cardiovascular Science, University College London, London, United Kingdom

Consumer-grade wearable devices may provide novel opportunities for assessing cardiovascular health in free-living conditions at scale. Photoplethysmography based devices can measure cardiovascular health parameters, but motion artefacts limit their accuracy. The Garmin's Health Snapshot is a recently introduced feature of selected smartwatches which measures resting heart rate (RHR), heart rate variability (HRV), respiratory rate and oxygen saturation (SpO_2) over a 2-minute resting period. The aim of this project was to compare RHR, HRV and SpO_2 measured through the Health Snapshot using a Gamin Venu 2 smartwatch to reference measurements from the ECG and pulse oximeters and to identify parameters affecting the agreement. ECG, pulse oximetry and the Health Snapshot were simultaneously recorded in n=27 healthy volunteers (aged 20-21, 63% male) at rest for 2 minutes. Measurements were conducted during free breathing as well as during controlled breathing conditions. HRV metrics (RMSSD and SDRR) and SpO_2 were derived from the ECG and a certified pulse oximeter, respectively, and used as reference to assess Health Snapshot metrics. Agreement was assessed using the absolute percentage error (APE), Spearman's correlation coefficients (r) and Bland Altman plots assessing bias and limits of agreement (LoA) (Table 1). Estimation of RHR was excellent, with almost perfect correlation, percentage error <2% and narrow LoA. Correlation between estimated and reference HRV was very good (r=0.85), while median absolute percentage error was between 10% and 20%. While all participants showed reference $SpO_2 \geq 98\%$, about 16.7% of participants had $SpO_2 < 95\%$ according to Garmin's estimate. Similar results were found during controlled breathing. Accuracy of Health Snapshot's metrics was not affected by gender or skin tone. In conclusion, in young health volunteers, estimates of RHR, HRV and SpO_2 using the Health Snapshot were excellent, very good and not very accurate, respectively.

	Reference	r	Bias (LoA)	APE [med (IQR]]
RHR	72.0 (62.2, 82.2) bpm	0.99	-0.5 (-3.9, 2.9) bpm	1.3 (0.2, 1.7) %
RMSSD	49.0 (24.5, 69.8) ms	0.85	-1.6 (-32.6, 29.5) ms	20.3 (8.8, 43.5) %
SDRR	60.0 (40.8, 87.8) ms	0.85	-5.1 (-30.4, 20.3) ms	11.3 (5.2, 19.7) %
SpO2	99 (99, 99) %	0.25	-2.1 (-7.4, 3.1) %	1.0 (1.0, 3.8) %

Table 1. Agreement between Health Snapshot and reference metrics (free breathing).